What is claimed is:

1   1.   A multi-tone signal communications method for
2   communicating information using N tones, where N is a
3   positive integer greater than one, the method comprising:
4   generating N analog signals, each one of the N
5   analog signals corresponding to a different one of the N
6   tones; and
7   transmitting the N analog signals into a
8   communications channel using M antennas, where M is an
9   integer and where 1<M≤N.

1   2.   The method of claim 1, wherein M=N.

1   3.   The method of claim 1, further comprising the step
2   of:
3   separately amplifying each of the N analog
4   signals prior to transmitting said N analog signals.

1   4.   The method of claim 3, wherein each of said N analog
2   signals has a duration corresponding to at least a symbol
3   transmission period and wherein each of the N analog
4   signals includes a periodic signal representing a symbol
5   to be transmitted during said symbol transmission period,
6   the method further comprising:
7   separately generating N signal prefixes, one
8   signal prefix being generated for each one of the N
9   analog signals from the one of the N periodic signals
10 included in the corresponding one of the N analog
11 signals.

1   5.   The method of claim 4, wherein the N periodic

2   signals and signal prefixes are generated in the

3   passband.

1   6.   The method of claim 4,

2   wherein each of the N analog signals has a

3   duration corresponding to multiple symbol transmission

4   periods and wherein said included periodic signal

5   represents a current symbol and wherein each of the N

6   analog signals further includes a periodic signal

7   representing a preceding symbol; and

8   wherein each one of the N signal prefixes is

9   generated from the corresponding one of the N analog

10   signals as a function of the periodic signal representing

11   the current symbol and the periodic signal representing

12   the preceding symbol.

1   7.   The method of claim 4, wherein each of the N signal

2   prefixes includes multiple parts and wherein the step of

3   separately generating N signal prefixes includes, for

4   each one of the N analog signals:

5   generating a first cyclic prefix part from the

6   included periodic signal representing the current symbol;

7   and

8   generating a second prefix part from the

9   included periodic signal representing the preceding

10   symbol and from the first cyclic prefix part.

1   8.   The method of claim 7, wherein the step of

2   generating a second prefix part includes cyclically

3   extending the periodic signal representing the included

4   preceding symbol and cyclically extending the first

5   cyclic prefix part to correspond to the same time period;

6   and

7   combining and attenuating the cyclically

8   extended portion of the first cyclic prefix part and the

9   cyclically extended portion to the included periodic

10   signal representing the preceding symbol.

1   9.   The method of claim 4, wherein each of the N signal

2   prefixes includes multiple parts and wherein the step of

3   separately generating N signal prefixes includes, for

4   each one of the N analog signals:

5   generating a first cyclic prefix part from the

6   included periodic signal representing the current symbol;

7   and

8   generating a second prefix part to be a

9   periodic signal, the beginning of the generated second

10   prefix part having the same phase as the periodic signal

11   representing the preceding symbol and the end of the

12   generated second prefix part having the same phase as the

13   first cyclic prefix part.

1   10.   The method of claim 6, wherein each of the N

2   periodic signals is a sinusoidal wave.

1   11.   The method of claim 6, wherein each of the N

2   periodic signals is a square wave.

1   12.   A multi-tone signal communications method for
2   communicating information using N tones, where N is a
3   positive integer greater than one, the method comprising:
4   generating in parallel, for each one of the N
5   tones, a separate periodic signal including at least one
6   high order harmonic signal component that is different
7   from the fundamental frequency signal component of said
8   tone; and
9   transmitting the generated N periodic signals
10 into a communications channel.

1   13.   The method of claim 12, wherein the periodic signal
2   generated for each of the N tones, includes multiple high
3   order harmonic signal components.

1   14.   The method of claim 12, wherein the generated
2   periodic signal includes a square wave.

1   15.   The method of claim 12, further comprising:
2   generating, in parallel, for each one of the N
3   tones, a separate periodic signal prefix.

1   16.   The method of claim 15, wherein the step of
2   generating a separate periodic signal prefix for each one
3   of the N tones includes, for each one of the N generated
4   prefixes:
5   generating a cyclic prefix portion; and
6   generating a continuity signal portion, the
7   continuity signal portion being generated as a function

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8 of a previously generated periodic signal and the current

9 generated periodic signal.

1 17. The method of claim 15, further comprising, for each

2 one of the N tones, combining in the passband, the

3 periodic signal corresponding to the one of the N tones

4 with the corresponding one of the N periodic signal

5 prefixes.

1 18. A multi-tone signal communications method for

2 communicating information using at least N tones, where N

3 is a positive integer greater than one, the method

4 comprising:

5   separately generating, for each one of the N

6 tones, a passband periodic signal representing a symbol;

7 and

8   transmitting the N generated passband periodic

9 signals.

1 19. The method of claim 18, wherein the passband

2 periodic signals for each one of the N tones are

3 generated in parallel; and

4   wherein the step of transmitting the N

5 generated passband periodic signals includes broadcasting

6 different ones of said N passband periodic signals using

7 different antennas.

1 20. The method of claim 18, comprising:

2   combining at least some of the N generated

3 passband periodic signals prior to transmission.

1   21. The method of claim 18, wherein at least some of the

2   N generated passband periodic signals include a high

3   order harmonic signal component in addition to a

4   fundamental frequency signal component, the high order

5   harmonic signal component having a frequency which is

6   higher than the frequency of the fundamental signal

7   component.

1   22. The method of claim 21, wherein each of the N

2   generated periodic signals is a square wave.

1   23. The method of claim 18, further comprising:

2   generating, a separate prefix for each of the N

3   generated passband periodic signals; and

4   combining, prior to transmission, each one of

5   the separate prefixes with the corresponding one of the N

6   generated passband periodic signals.

1   24. The method of claim 23, wherein the prefixes for

2   each of the N passband periodic signals are generated in

3   parallel.

1   25. The method of claim 23, wherein the step of

2   combining each one of the separate prefixes with the

3   corresponding one of the N generated passband periodic

4   signals includes:

5   prepending the generated prefix to the

6   corresponding one of the N generated passband periodic

7   signals.

1 26. The method of claim 23, wherein generating a
2 separate prefix for each of the N generated passband
3 periodic signals includes, for each separate prefix:
4   generating a first cyclic prefix part; and
5   generating a second prefix part, the second
6 prefix part being generated using a different generation
7 technique than the first prefix part.

1 27. A periodic signal processing method, the method
2 comprising:
3   generating a multi-part prefix from a first
4 periodic signal, the step of generating a multi-part
5 prefix from the first periodic signal including:
6   performing a cyclic extension operation on
7   the first periodic signal to generate a cyclic
8   prefix portion;
9   generating a continuity prefix portion;
10   and
11   appending the cyclic prefix portion to the
12   end of the continuity prefix portion.

1 28. The method of claim 27, wherein generating a
2 continuity prefix portion includes:
3   processing the cyclic prefix portion to
4 generate the continuity prefix portion from the cyclic
5 prefix portion.

1 29. The method of claim 28, wherein generating a
2 continuity prefix portion includes:

3   processing a preceding periodic signal to

4   generate the continuity prefix portion from the preceding

5   periodic signal.

1   30.   The method of claim 27, wherein generating a

2   continuity prefix portion includes:

3   processing the cyclic prefix portion and a

4   preceding periodic signal to generate the continuity

5   prefix portion from both the cyclic prefix portion and

6   the preceding periodic signal.

1   31.   The method of claim 30, wherein said processing of

2   the cyclic prefix portion and a preceding periodic signal

3   includes:

4   performing a cyclic extension operation on the

5   cyclic prefix portion to generate a first cyclic

6   extension;

7   performing another cyclic extension operation

8   on the preceding periodic signal to generate a second

9   cyclic extension, the first and second cyclic extensions

10   corresponding to a signal time period which is the same

11   for both the first and second cyclic extensions; and

12   combining the first and second cyclic

13   extensions corresponding to said signal time period to

14   generate said continuity prefix portion, the step of

15   combining the first and second cyclic extensions

16   including:

17   windowing the combined cyclic extensions

18   using an attenuating window.

1   32. The method of claim 31, wherein each of said cyclic

2   extension operations includes copying a portion of the

3   signal upon which said cyclic extension operation is

4   performed.

1   33. The method of claim 27, wherein the continuity

2   prefix portion has a frequency which is different from

3   the frequency of the first periodic signal but has a

4   phase at the point where the cyclic prefix portion is

5   appended to the continuity prefix portion that is the

6   same as the phase of the cyclic prefix portion.

1   34. The method of claim 27, wherein the continuity

2   prefix portion has a phase at the beginning of the

3   continuity prefix portion that is the same as the phase

4   of a preceding periodic signal.

1   35. The method of claim 27, wherein the first periodic

2   signal is one of N period signals corresponding to N

3   different tones of a multi-tone signal, where N is a

4   positive integer greater than one, the method further

5   comprising:

6   generating for each of the N periodic signals,

7   other than the first periodic signal, a separate

8   multi-part prefix from a corresponding one of the N

9   periodic signals, thereby generating N-1 multi-part

10   signal prefixes in addition to the multi-part prefix

11   generated from the first periodic signal.

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1 36. The method of claim 35, further comprising:

2   prepending each of the generated N-1 multi-part

3 prefixes and the generated multi-part prefix generated

4 from the first periodic signal to the corresponding ones

5 of the N periodic signals from which the multi-part

6 prefixes were generated.

1 37. The method of claim 36, further comprising the step

2 of:

3   filtering each of the N periodic signals with

4 prepended multi-part prefixes in parallel; and

5   transmitting the filtered N periodic signals

6 with prepended multi-part prefixes into a communications

7 channel.

1 38. The method of claim 37, wherein the step of

2 transmitting the filtered N periodic signals with

3 prepended multi-part prefixes includes broadcasting

4 different ones of the N periodic signals using different

5 antennas.

1 39. The method of claim 38, further comprising:

2   allowing the N broadcast periodic signals to

3 combine in the communications channel to form an N tone

4 OFDM signal.

1 40. A method of broadcasting signals representing tones

2 of an N tone multi-tone signal, for a first period of

3 time corresponding to multiple symbol transmission

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4 periods and for a second period of time also

5 corresponding to multiple symbol transmission periods,

6 where N is a positive integer greater than one and the

7 tones in the N tone multi-tone signal are fixed for the

8 first and second periods of time but include different

9 tones in each of the first and second periods of time,

10 the method comprising:

11 broadcasting signals corresponding to different

12 tones of the N tone multi-tone signal during the first

13 period of time using a fixed first set of M different

14 antennas where M is an integer and where $M \leq N$; and

15 broadcasting signals corresponding to different

16 tones of the N tone multi-tone signal during the second

17 period of time using a fixed second set of M different

18 antennas, at least one antenna in the fixed second set of

19 M different antennas being different from the antennas

20 included in the fixed first set of M different antennas.

1 41. A method of sequentially transmitting symbols in a

2 multi-tone signal communication system using N tones per

3 symbol period, wherein the N tones remain the same for

4 multiple symbol periods, the time period in which the N

5 tones remain the same being a dwell, the method

6 comprising:

7 for each symbol transmission period of the

8 dwell:

9   transmitting N signals corresponding to

10   each one of the N tones of the multi-tone

11   signal, each one of the N signals being

12   transmitted on a corresponding one of a first

13	plurality of antennas, the antenna being used
14	to transmit signals corresponding to a
15	particular tone during the dwell remaining the
16	same throughout the dwell.

1	42. The method of claim 41, further comprising the step
2	of:
3	for each symbol transmission period of a second
4	dwell:
5	transmitting N signals corresponding to
6	each one of the N tones of the multi-tone
7	signal, each one of the N signals being
8	transmitted on a corresponding one of a second
9	plurality of antennas, the antenna being used
10	to transmit signals corresponding to a
11	particular tone during the second dwell
12	remaining the same throughout the second dwell,
13	the second plurality of antennas including at
14	least one antenna which is different from the
15	antennas included the first plurality of
16	antennas.

1	43. The method of claim 41, further comprising:
2	for each of a plurality of symbol transmission
3	periods in the dwell:
4	rotating the constellation of symbols from
5	which consecutive symbols are transmitted using
6	one of said N tones by a fixed amount; and
7	selecting a symbol to be transmitted from
8	a constellation of symbols to be transmitted

9   using a signal corresponding to one of said N

10   tones.

1   44. The method of claim 43, wherein the rotation of the

2   constellation during each of the plurality of symbol

3   transmission period has a cumulative rotational effect on

4   the constellation from which symbols are selected causing

5   the rotation of the symbols in one symbol transmission

6   period to effect the constellation from which symbols are

7   selected during the next symbol transmission period.

1   45. The method of claim 43, wherein the rotation of the

2   constellation during each of the plurality of symbol

3   transmission periods is by a fixed additive amount which

4   does not effect the position of the symbols in the

5   constellation from which the next symbol is selected.

1   46. The method of claim 43, wherein said fixed amount by

2   which the constellation of symbols is rotated is a

3   function of the tone frequency.

1   47. The method of claim 46, wherein said fixed amount by

2   which the constellation of symbols is rotated is also a

3   function of the duration of a multi-part prefix to be

4   transmitted with the selected symbol.

1   48. A transmitter for broadcasting a signal

2   corresponding a multi-tone signal, the transmitter

3   comprising:

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4   a plurality of first through Nth periodic

5 signal generators for generating periodic passband

6 signals representing symbols, where N is a positive

7 integer greater than 1, each one of the N periodic signal

8 generators generating a periodic signal having a

9 frequency corresponding to a different one of N tones of

10 said multi-tone signal; and

11   a plurality of M antennas, where $1<M\leq N$, each

12 one of the M antennas being coupled to at least one of

13 the first through Nth periodic signal generators, each

14 periodic signal generator being coupled to a single one

15 of said M antennas.

1 49. The transmitter of claim 48, wherein M=N, each one

2 of said N periodic signal generators being coupled to a

3 different one of said M antennas.

1 50. The transmitter of claim 49, wherein the plurality

2 of first through Nth periodic signal generators are

3 housed in a portable device and are powered by a battery.

1 51. A system for generating and transmitting signals

2 corresponding to an N tone multi-tone signal, where N is

3 a positive integer greater than 1, the system comprising:

4   N periodic signal generator circuits for

5 generating periodic signals, each periodic signal

6 corresponding to a different tone one of the N tones of

7 the multi-tone signal; and

8   N prefix generator circuits for independently

9 generating periodic signal prefixes, each one of the N

10   prefix generator circuits being coupled to a different

11   corresponding one of the N periodic generator circuits.

1   52.   The system of claim 51, further comprising:

2   N filters for independently filtering the N

3   periodic signals including prefixes generated by the N

4   prefix generator circuits, each one of the N filters

5   being coupled to a different corresponding one of the N

6   prefix generator circuits.

1   53.   The system of claim 52, further comprising:

2   a plurality of M antennas, where M is an

3   integer and where $1 < M \leq N$, each of the N filters being

4   coupled to a single one of the M antennas and each one of

5   the M antennas being coupled to at least one of the N

6   filters.

1   54.   The system of claim 53, wherein M = N.

1   55.   The system of claim 54, wherein M < N, the system

2   further comprising, at least one analog combing circuit

3   for combining signals from a subset of said N filters

4   into a signal filter and for coupling each filter in the

5   subset of said N filters one of said M antennas.

1   56. The system of claim 51, wherein each prefix generator

2   circuit includes:

3   means for generating a multi-part prefix

4   including a first cyclic prefix portion and a second

5   signal continuity portion.

1   57.   The system of claim 51, wherein each of the N prefix

2   generator circuits generates a separate prefix, each one

3   of the N separate prefixes having the same duration.

1   58.   The system of claim 57, wherein each of the N

2   periodic signal generators includes:

3   square wave generating means, each one of said

4   N periodic signals including a square wave having a

5   frequency component corresponding to one of said N tones

6   of the multi-tone signal.

1   59.   The system of claim 57, wherein each of the N

2   periodic signal generators includes:

3   sinusoidal generating means, each one of said N

4   periodic signals including a sinusoidal signal having a

5   frequency component corresponding to one of said N tones

6   of the multi-tone signal.